MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

ETM3056 – MULTIMEDIA AND COMMUNICATION NETWORKS

(TE)

24 OCTOBER 2017
9.00 a.m. - 11.00 a.m
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages with 4 Questions only.
2. Attempt **ALL** questions. Each question carries an equal total mark and the mark distribution for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) For compression techniques, answer the following questions.
   (i) Briefly explain the difference between lossy and lossless compression schemes.
   (ii) Give an example of a lossy compression scheme and another example of a lossless compression scheme.
   (iii) Briefly describe three types of redundancies considered for compression.

[2+2+6 Marks]

(b) A message which goes as AA000BB is to be compressed.
   (i) Suggest one compression method which is best applied to compress this message and briefly justify your answer.
   (ii) List the codewords generated by using the suggested compression technique.
   (iii) If each codeword is considered as one symbol or character, what is the compression ratio?

[2+3+2 Marks]

(c) Variable length coding is widely used for data compression.
   (i) Give two examples of variable length coding schemes and briefly describe them.
   (ii) Three equally probable symbols are to be compressed using a compression scheme. What is the minimum number of bits per codeword which can be produced in this case?

[4+2 Marks]

Continued...

Question 2

(a) The fast growing communication networks are moving towards integrating different entities to provide better services to the users:

(i) Analyze the third wave of the next generation networks (NGN) in terms of the advantages over the first and the second waves and give one important feature required in the third wave of NGN as compared to the second wave.

(ii) Design an NGN multimedia system based on the four-layer model in NGN.

[4+4 Marks]

(b) An engineer is assigned to design a T-1 line between two sites and a 32 kbps speech coding is used instead of PCM.

(i) Explain how the T-1 line can be used to carry twice the number of calls.

(ii) If the transmission rate of the trunk or the output transmission rates of the multiplexers in T-1 remains the same, what is now the new number of input channels of each multiplexer in this T-1 system?

[5+2 Marks]

(c) After designing a T-1 carrier system, a group of engineers are required to analyze performance of the newly designed system. This system uses a framing bit to identify the beginning of each frame which carries the speech signal. This is done by alternating the value of the framing bit at each frame, assuming that no other bits can sustain an alternating pattern indefinitely. Framing is done by examining each of 193 possible bit positions successively until an alternating pattern of sufficient duration is detected. Assume that each information bit takes a value of 0 or 1 independently and with equal probability. Consider an information bit position in the frame which starts as zero and the number of observations before the first violating pattern, i.e. the subsequent framing bits are not alternating, is denoted as random variable X.

(i) What is the probability $p[X \leq 1]$ i.e. the probability at which the violating pattern is observed before the second observation of the framing bit is made? Justify your answer.

(ii) Find $p[X = 2], p[X = 3], p[X = 4]$ and hence determine $p[X = n]$ for $= 1,2,\cdots,\infty$.

(iv) Using the answer in Question 2(c)(ii), calculate the average number of times this bit position needs to be observed before the alternating pattern is found to be violated.[Hint: $\sum_{i=n}^{\infty} ip^{i-1} = \sum_{i=n}^{\infty} \frac{d}{dp} p^i$ for $n \geq 1$]

[2+4+4 Marks]

Continued...

Question 3

(a) Compare IEEE 802.3 and IEEE 802.11 to briefly describe three differences between wired and wireless LANs.

[6 Marks]

(b) For data packet radio networks, discuss the advantages and disadvantages of providing reliability by implementing error correction/control at these three layers
(i) The physical layer,
(ii) The MAC layer,
(iii) The LLC layer.

[3+4+2 Marks]

(c) Suppose N stations are connected to an extended Ethernet LAN, as shown below, operating at the rate of 10 Mbps. Assume that the efficiency of each Ethernet is 80 percent. Also assume that each station transmits frames at the average rate of R bps, and each frame is equally likely to be destined to any station (including to itself).
(i) What is the maximum number of stations, N, that can be supported if R is equal to 100 kbps?
(ii) If the bridge is replaced with a repeater, what is the maximum number of stations that can be supported? (Assume that the efficiency of the entire Ethernet is still 80 percent.)

[7+3 Marks]

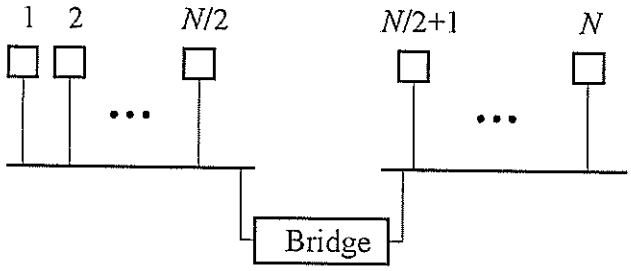

Figure Q3 (c)

Continued...

Question 4

(a) Worldwide Interoperability for Microwave Access (WiMAX) is a wireless broadband technology developed on the IEEE 802.16 standard.

(i) Explain three functions of WiMAX base stations in the access service networks, as seen in Figure Q4 (a).

(ii) Name one modulation format and one channel bandwidth typically used for WiMAX?

[6+4 Marks]

(b) Long-term Evolution (LTE) is a new cellular telecommunication technology developed to significantly increase the achievable data rates in both downlinks and uplinks

(i) What is the number of subcarriers per resource block used for the data transmission in LTE?

(ii) If one resource block is allocated to one user over a carrier bandwidth of 15 MHz with 16-QAM and 3/4 coding rate, normal cyclic prefix, what is the maximum data rate for the user?

[2+2 Marks]

(c) WiMAX is designed to offer high-speed data rates for broadband users.

(i) Explain the basic specifications of physical and MAC layers in WiMAX.

(ii) What are the methodologies implemented to ensure QoS in WiMAX?

(iii) Compare the differences between WiMAX time division duplex (TDD) and frequency division duplex (FDD).

[4+4+3 Marks]

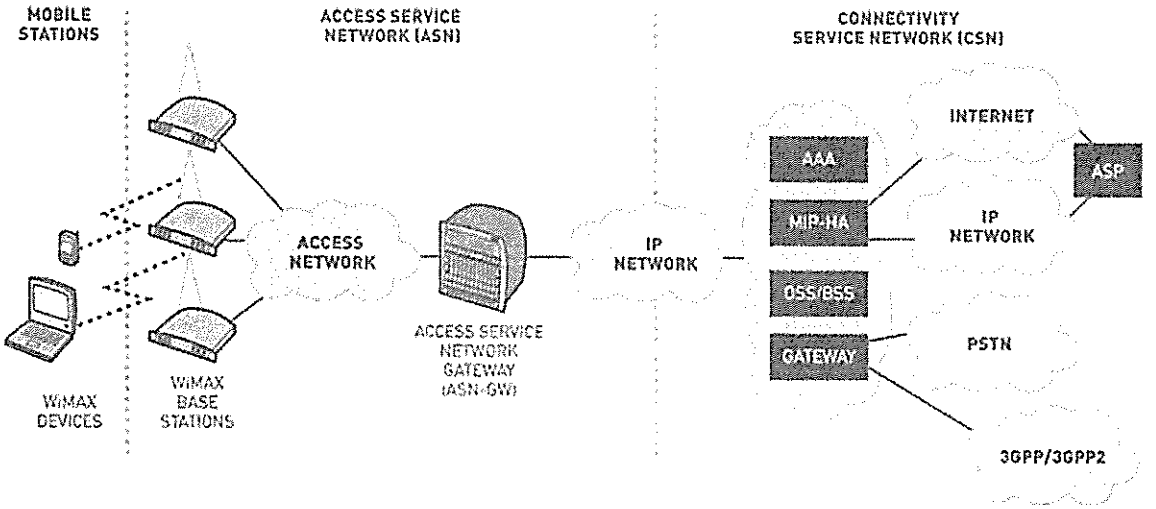

Figure Q4(a)

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